Observations on the Biology of the Dwarf Galaxiid, *Galaxiella pusilla* (Mack) (Pisces: Galaxiidae)

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Introduction

Fishes of the family Galaxiidae are confined mainly to the southern hemisphere, with species occurring in South Africa, South America and the Falkland Islands, New Zealand and outlying islands, New Caledonia, Lord Howe Island, mainland Australia and Tasmania (Frankenberg 1969).

Six species of galaxiids, belonging to two genera, are found in Victorian waters: *Galaxias brevipinnis*, *G. maculatus*, *G. olidus*, *G. rostratus*, *G. truttaceus*, and *Galaxiella pusilla* (R. M. McDowall, New Zealand Fisheries Research Division, pers. comm.).

The dwarf galaxiid has previously been placed in the genera *Galaxias* (Mack 1936; Andrews 1976) and *Brachygalaxias* (Scott 1942; Munro 1956; Frankenberg 1969; Lake 1971).

However, McDowall (1973) questioned the inclusion of *Galaxias pusillus* in the genus *Brachygalaxias* and proposed the genus *Galaxiella* (McDowall 1978) to include the dwarf galaxiid and two similar Western Australian species, *Galaxiella nigrostriata* and *Galaxiella munda*.

The biology of the dwarf galaxiid is poorly understood. Massola (1938) reported the spawning of the dwarf galaxiid in an aquarium and Frankenberg (1974) included brief information on its habitat. The present study was undertaken to increase the available knowledge concerning the biology of the dwarf galaxiid.

This paper presents information gained from preliminary observation of the dwarf galaxiid, *Galaxiella pusilla*, both in field and in laboratory aquaria.

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Materials and Methods

Field observations were made from mid-April until early September (1977) at Cardinia Creek, Berwick, Diamond Creek, Tonimbuk, and Narracan Creek, Moe.

Aquarium observations were made from about 20 specimens, collected from Narracan Creek, Moe, in mid-April and placed in a 20 l aquarium, and from about 50 specimens collected from Diamond Creek and Narracan Creek in early and late August, and placed in 80 l aquaria.

The aquaria had a gravel substrate and were thickly planted with aquatic vegetation. Filtration was supplied by sub-sand filter systems.

Specimens were collected using fine mesh dip nets. All measurements (except where otherwise stated) were taken from material preserved in 10% formalin.

Description of Adult Fish

The dwarf galaxiid is the only galaxiid known to exhibit sexual dimorphism. No information is available yet as to whether the related Western Australian galaxiids exhibit this phenomenon.

Males are smaller and more brightly coloured than females. Total lengths of a sample of 21 mature males ranged from 29.8-33.5 mm, and maximum body depth from 4.0-4.5 mm.

Total lengths of a sample of 16 mature females ranged from 32.5-40.3 mm, and a maximum body depth from 6.3-6.9 mm.

The dorsal surface of the male is light brown, and often has a few scattered small black dots. Laterally, two black horizontal lines run along the body of the fish, the

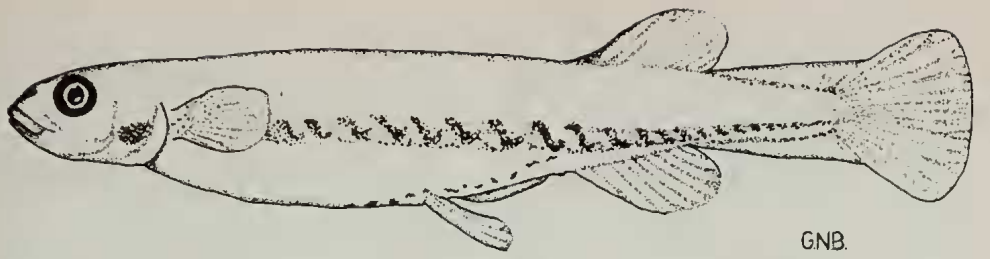

Fig. 1. *Galaxiella pusilla*. female. 36.5 mm. T.L. Cardinia Creek, Beaconsfield.

uppermost line starting above the eye and running through to the caudal peduncle, while the lower line starts from the mid-operculum and runs through to the anal fin, then ventrally to the caudal peduncle.

Between these two black lines is a bright orange-red stripe. The ventral surface is white, often with two rows of small black spots extending back from the jugular region to the ventral fins.

The dorsal and upper lateral surfaces of the female are light brown, and a black line runs mid-laterally from the operculum to the caudal peduncle. Often a purplish-green iridescent line is present just above the black line. The ventral surface is white.

Distribution

The dwarf galaxiid is widespread throughout Victoria (Fig. 2), probably more so, especially in the Gippsland region, than previous reports (Andrews 1976; Frankenberg 1969; Munro 1956) indicate.

The species is also found in far eastern South Australia (C. J. M. Glover, South Australian Museum; pers. comm.), Flinders Island, and the Waterhouse district of north-eastern Tasmania (Frankenberg 1974).

Fig. 2. Distribution of *Galaxiella pusilla* in Victoria.

Description of Habitat

The dwarf galaxiid is typically found in still waters such as swamps, drains and backwaters of creeks and streams. The waters are usually shallow, often less than 30 cm deep and have abundant aquatic vegetation. In larger pools the galaxiid is usually captured in the marginal vegetation surrounding the edge of the pool.

The waters inhabited by the galaxiid are often temporary, drying up partially or completely during summer, and being replenished by rainfall or floodwaters from a watercourse during the wetter months.

Non-breeding Behaviour

Little is known of the habits of this diminutive fish in the wild. Adult fish were not observed during the day, although the dense surface vegetation typical of their habitat precludes observation below the surface. However, juvenile fish were readily observed on the surface in vegetation-free areas of the pools. They often congregated in groups of as many as 20 individuals but schooling behaviour* was not evident.

The dwarf galaxiids survived satisfactorily in aquaria, especially if these were densely planted with aquatic plants. The fish were active during the day, occupying most levels of the aquarium, but apparently preferred the lower strata and rarely approached the surface. Schooling was not observed, and intraspecific aggression ap-

*Fish moving as a co-ordinated group.

peared minimal, if not absent. When frightened by some external stimulus, such as sudden movement or bright light, the fish immediately darted to the bottom of the aquarium and hid amongst the plants.

The diet of the dwarf galaxiid is not known, but in aquaria they fed on plant material, such as filamentous algae, and accepted insect larvae and other freshwater invertebrates. They also accepted commercially-prepared fish food.

Breeding Biology

Little is known of the breeding biology of the dwarf galaxiid in its natural habitat. Gravid females and larval fish were observed in the study areas from late July to early September.

A sample of 26 larval fish taken from Diamond Creek in late August measured 5.1-19.3 mm.

Dwarf galaxiids taken from Narracan Creek in early April and placed in an aquarium spawned eight days later. When captured the females did not appear to be gravid, but ripened rapidly when introduced to the aquarium. Females captured from the same location in early and late August were obviously gravid and spawned within 48 h of introduction into an aquarium. The first indication of spawning was given when a male gently nudged the jugular and abdominal regions of a female. Often two, and sometimes three males were observed displaying this behaviour towards a single female.

The intensity of the red stripe did not vary during this prespawning activity, and there was no elaborate display pattern.

At this stage if the female was not ready to spawn, she rapidly swam away from the courting male(s); if ready to spawn, she allowed the attentions of the courting male(s) to continue.

Then the female and one male entered dense vegetation and investigated numerous sites on the leaves and stones on which to deposit the eggs. When a site had been selected, the pair brushed their bodies rapidly forward over the leaf or stone.

Two movements facilitating egg deposition were observed. The female made a rapid pass and, pressing the genital aperture momentarily to the selected site, deposited a single egg on the top surface of stones or leaves. On narrow-leaf plants the egg may be sheared off as the female passed, adhering to the lower surface. However, the preferred site for depositing eggs appeared to be the lower surface of a leaf. The egg is deposited by the female moving forward under the leaf, rolling over quickly and depositing the egg. The male fish then moved past the egg one or more times, but precise moment of fertilisation is not known.

The prespawning behaviour often lasted several minutes although spawning occurred in a few seconds. After the egg had been laid the pair separated and paid no further attention to the egg. Pair bonds were of a brief duration — males spawned with any female that was ready, and after spawning searched out other females ready to spawn. Females spawned several times in a single day.

At temperatures of 16-21C and a pH of 6.9 the eggs hatched in 10-14 days. The "eyed-stage" was visible after 5-6 days. After emerging tail-first, the larvae fell to the bottom of the aquarium. A sample size of 6 larvae measured 4.2-4.8 mm long. A prominent yolk-sac was visible. Within 1-2 days the young fish swam to the surface and remained just below the water surface. The yolk-sac was fully absorbed within 3 days, and the larval fish swam freely near the water surface.

No more than 18 eggs were laid in any 24 h period, and at least two females contributed to this number.

Examination of the ovaries of 12 mature females in breeding condition from the three study areas revealed 155-197 eggs per female. These fish were obtained in late August, after the spawning season had been in progress for at least one month. The diameter of a sample size of 15 unfertilized mature eggs ranged from 0.7-0.8 mm, while the diameter of 12 fertilised, unpreserved eggs ranged from 1.1-1.3 mm.

Discussion

Little is known about the breeding biology of galaxiids although that of *Galaxias maculatus* ((McDowall 1968; Pollard 1971) and *G. vulgaris* (Cadwallader 1976) has been studied. Comparison of the reproductive modes of the three species reveals an interesting difference in breeding biology.

Galaxias maculatus lives in freshwater, but migrates downstream during the breeding season to spawn on the grassy banks of estuaries covered by the peak of a spring tide. The eggs develop, out of water, until the next peak tide, about two weeks later, covers the eggs, which then hatch. The larvae are washed out to sea, where they develop. After several months the immature fish migrate into fresh water. As many as 13 000 eggs are laid (McDowall 1968) apparently on the estuarine grasses, as no nest is made.

G. vulgaris (a New Zealand species) is confined to freshwater, and lays fewer eggs than *G. maculatus*.

Cadwallader (1976) recorded 284-1911 eggs per female. *G. vulgaris* also constructs a nest, a depression in the gravel beneath overhanging rocks, into which several females may spawn.

The construction of a nest, a more precise breeding behaviour, increases the chances of fertilization of the eggs, and with this increase in fertilization success there is a decrease in fecundity.

Our observations of the spawning habits of the dwarf galaxiid, and the numbers of eggs appearing in the aquarium each day suggest that each female lays only a few eggs a day, probably no more than 10. Therefore each female probably spawns over an extended period, possibly two weeks or more. Massola (1938) observed that a female dwarf galaxiid laid 59 eggs in two days, then died.

The most precise method of fertilization and consequently that providing the highest chance of an egg being fertilized is the laying of a single egg in a predetermined spot. Thus the dwarf galaxiid shows the most refined reproductive behaviour so far known among the Australian galaxiids.

The small South American species *Brachygalaxias bullocki* spawns in a similar fashion (Campos 1972), but has a lower fecundity (50-120 eggs; average 100) and slightly larger eggs (1.0-1.9 mm) than the dwarf galaxiid. About 7 eggs are laid in a 24 h period.

B. bullocki may show a slightly greater refinement than the dwarf galaxiid in that the pair bonds last for several hours, which, even though temporary, are considerably longer than those of the dwarf galaxiid.

The habitat of the dwarf galaxiid poses an interesting question. How do populations of the species survive when their habitat, usually shallow, still waters, dry up partially or completely during summer. In such hostile environments fish have developed several methods of surviving, but which one the dwarf galaxiid employs is not known.

Some galaxiids are capable of aestivation, usually burying themselves beneath rocks or logs as the water recedes. This has been demonstrated in two of the New Zealand *Neochanna* sp. (McDowall 1970) and may occur in some of the Tasmanian galaxiids (Frankenberg 1974).

If the dwarf galaxiid dies out from hostile areas as the water dries up, it may be able to recolonize such areas rapidly when sufficient water is available.

What we already know of the dwarf galaxiid's lifestyle shows that its survival depends on suitable habitats such as shallow, still waters.

Where rivers are channelized and water courses are encased in concrete, there is less prospect of the creation of suitable habitats such as would occur during flooding. The draining of swamps where the dwarf galaxiid lives is also detrimental to its survival.

It is hoped that future studies may help answer some of the many questions posed by the life history of the dwarf galaxiid, which is certainly unique among the galaxiids of Victoria.

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